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For

A SOCKET FOR A MICROELECTRONIC COMPONENT

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A SOCKET FOR A MICROELECTRONIC COMPONENT

BACKGROUND OF THE INVENTION

1) Field of the Invention

[0001] This invention relates to a socket for a microelectronic component.

2) Discussion of Related Art

[0002] Integrated circuits are usually manufactured in and on silicon wafers that are subsequently singulated into individual dies. A microelectronic die is mounted on a package substrate for purposes of rigidity and to provide power, ground and signal to the integrated circuit. A package substrate is inserted into a holding formation of a socket that is mounted on a motherboard, where contacts on the opposing side of the package substrate electrically connect to contacts within the holding formation of the socket.

[0003] The socket has a plurality of openings within the socket body. Electrical conductors are inserted into the openings and make contact with electrical planes within the socket and also serve to electrically connect with lower contacts on the package substrate. The electrical conductors also have opposing contacts on the lower side of the socket to electrically connect to upper contacts on a carrier substrate. The socket includes clamps that generate a force on the lands of the package substrate to counter the force generated by spring portions of the electrical conductors when the package substrate is inserted into the holding formation of the socket.

[0004] A plurality of electrical conductors can provide power, ground or signal to the integrated circuit. For example, the plurality of electrical conductors electrically contacting a power plane, are all electrically connected, and electrically disconnected

from the ground and signal planes.

[0005] The disadvantage of previous socket technology was meeting current power delivery requirements. Current high power delivery requirements equates to high resistance and inductance at the electrical contacts, resulting in a decrease in power delivery and performance to the integrated circuit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The invention is described by way of example with reference to the accompanying drawings wherein:

[0007] Figure 1 is a perspective view of components of a microelectronic assembly, including; a microelectronic die and a package substrate, which make up a microelectronic component, a socket and a carrier substrate;

[0008] Figure 2 is a cross-sectional view of the socket in detail, including a plurality of electrical conductors to be inserted and a socket body;

[0009] Figure 3 is a cross-sectional view of the socket of Figure 2, illustrating the insertion of the plurality of electrical conductors into the socket body;

[0010] Figure 4 is a top view of the assembled microelectronic assembly, the components of which consist of; a microelectronic die and a package substrate, which make up a microelectronic component, a socket and a carrier substrate;

[0011] Figure 5 is a side-view of the assembled microelectronic assembly of Figure 4, including; the microelectronic die and package substrate, which make up the microelectronic component, the socket and the carrier substrate.

[0012] Figure 6 is cross-sectional view of the package substrate, the socket and the carrier substrate, illustrating the movement of spring portions in response to the insertion of the package substrate during assembly.

DETAILED DESCRIPTION OF THE INVENTION

[0013] Figure 1 of the accompanying drawings illustrates a microelectronic assembly 10 according to an embodiment of the invention, which includes a carrier substrate 12, a socket 14 and a microelectronic component 16.

[0014] Figure 2 illustrates the components of the socket 14 in more detail, including a socket body 18, a power conductor 20, a ground conductor 22 and a signal conductor 24 and a plurality of electrical conductors 26.

[0015] The socket body 18 includes alternating insulating and conductive layers. The conductive layers include the power conductor 20, ground conductor 22 and signal conductors 24. The socket body 18 has a horizontal base portion 28 and vertical sidewalls 30 that jointly form a recess holding formation 32 for receiving the microelectronic component 16. An array of horizontally spaced vertically extending openings 34 are formed within the base portion 28 and socket body 18.

[0016] The power conductor 20 includes a horizontal power plane 36 and a plurality of vertical liners 38P(i) and 38P(ii). The power plane 36 is formed on an upper surface of the horizontal base portion 28. The vertical liners 38P(i) and 38P(ii) line the inside of two respective openings 34. The power plane 36 is connected to all the vertical liners 38P(i) and 38P(ii), and is electrically disconnected from ground conductor 22 and signal conductors 24.

[0017] The ground conductor 22 includes a horizontal ground plane 40 and a plurality of vertical liners 38G(i) and 38G(ii). The ground plane 40 is formed on the lower level of the socket body 18. The vertical lines 38G(i) and 38G(ii) line the inside of two respective openings 34. The ground plane 40 is connected to all the vertical liners 38G(i)

and 38G(ii).

[0018] The signal conductor 24 includes a horizontal signal plane 42 and a plurality of vertical liners 38S(i) and 38S(ii). The signal plane 42 is formed between the power 20 and ground 22 planes, and is electrically isolated from the power 20 and ground 22 conductors of the socket body 18. The vertical liners 38S(i) and 38S(ii) line the inside of two respective openings 34. The signal conductor 24 is connected to all the vertical liners 38S(i) and 38S(ii).

[0019] Each electrical conductor 26 includes a respective spring portion 44, interconnection element 46, stop component 48, solder ball 50 and protrusions 52. The spring portion 44 extends upwardly from the center of interconnection element 46 and has a diameter smaller than one of the openings 34. The interconnection element 46 has a diameter slightly smaller than the diameter of the openings 34. The stop component 48 has a diameter that is larger than that of the openings 34. Solder ball 50 is located at a bottom surface of the stop component 48.

[0020] Each protrusion 52 is circumferentially around an outer surface of the respective interconnection element 46. A distance D1 from the stop component 48, to a first lowest protrusion 52P(i) is substantially the same on all the interconnection elements 46. In addition, a distance D2 to a second higher protrusion 52P(ii) is substantially the same height each interconnection element 46.

[0021] As Figure 3 illustrates, the spring portion 44 enters the opening 34, followed by the interconnection element 46. The protrusions 52 frictionally fit to the sides of the openings 34 contacting either the power 20, the ground 22 or the signal conductor 24. The stop component 48 limits the distance that each respective electrical conductor 26

travels into the socket body 18. The spring portion 44 then extends this same distance into the recess holding formation 32 and is subsequently bent as illustrated in Figure 6. The solder balls 50 are located at the bottom surface of the stop component 48, and as illustrated in Figure 6, each respective solder ball 50 is electrically connected a respective upper carrier contact terminals 60 of the carrier substrate 12.

[0022] The electrical conductors 26A and 26B electrically connect to the power conductor 20 and are electrically disconnected from the ground 20 and signal conductors 22. The electrical conductors 26C and 26D electrically connect to the ground conductor 22 and are electrically disconnected from the power 20 and signal conductors 22. The electrical conductors 26E and 26F are electrically connected to the signal conductor 24 and electrically isolated from the power 20 and ground conductors 24.

[0023] Figure 4 and 5 illustrate the components of the microelectronic assembly 10 which include the carrier substrate 12, the socket 14, the microelectronic component 16, but further includes clamps 58. The microelectronic component includes a package substrate 54 and a microelectronic die 56 mounted to the package substrate 54.

[0024] The package substrate 54 is slightly smaller and fits tightly within the socket holding formation 32 of the socket 14. The microelectronic die 56 has lower terminal contacts that are electrically and structurally connected to upper terminal contacts of the package substrate 54, thus the package substrate 54 provides structural rigidity to the microelectronic component 16 and electrical communication to and from an integrated circuit formed in the microelectronic die 56.

[0025] The clamps 58 are located outside the sidewalls 30 and housed on the socket 14. The microelectronic component 16 is lowered into the socket holding formation 32,

the clamps 58 exert force on the package substrate 54 in opposition to force generated by spring portions 44, depressing the spring portions 44 of the electrical conductors resulting in a high-quality electrical connection.

[0026] Figure 6 illustrates the insertion of the package substrate 54 of the microelectronic component 16 into the socket holding formation 32. Each respective spring portion 44 depresses, electrically contacting a respective package terminal 62 formed on a lower side of the of the package substrate 54 of the microelectronic component 16. The carrier substrate 12, including upper carrier contact terminals 60, each respectively contacting a respective solder ball 50 of the socket 14.

[0027] In use, the socket provides transmission of charge to and from the integrated circuit. Electrical current is received by the socket 14 through the carrier substrate 12 upper carrier contact terminals 60 and to the respective solder ball 50. Interconnection element 46 of the respective electrical conductor 26 receives charge though the solder ball 50 and emits the respective electrically connected conductor, being ground, power or signal, to the package terminal 62 of the package substrate 54 though the spring portion 44 and to a second electrically connected interconnection element of a electrical conductor 26 through protrusions 52.

[0028] Power flows though electrically connected electrical conductors 26A and 26B, while electrically disconnected from ground and signal planes, ground flows though electrically connected electrical conductors 26C and 26D, while electrically disconnected from power and signal planes and signal flows though electrically connected electrical conductors 26E and 26F, isolated from ground and signal.

[0029] The package terminal 62 on the package substrate 54 transmits the charge

received from the spring portion 44 to the microelectronic die 56. The microelectronic die 56 has lower terminal contacts that are electrically and structurally connected to upper terminal contacts of the package substrate 54. The microelectronic die provides electrical communication to and from an integrated circuit formed within in the microelectronic die 56.

[0030] Integrated circuits operate at a specific frequency. Frequency will determine how fast instructions are computed within a given computer. Computers are processing larger amounts of information and at greater speeds, requiring more power. In order to meet increased power demands a reduction electrical parasitics is essential. One advantage of the socket design includes the embedding of planes within the socket body 18 in a way that allows for lateral flow of charge, this lowers resistance, inductance and creates a more efficient power delivery to the integrated circuit.

[0031] The socket design also provides for an accurate cost-effective ease of assembly. Its advantage is its ability to provide for a insertion of each electrical conductor 26, where each electrical conductor 26 has a first set of protrusions 52P(i) located at substantially the same distance from the stop component 48 and a second set of protrusions 52P(ii), located higher than the first, are at substantially the same distance from the stop component 48 can be inserted into any opening 34 within the socket body 18, thus eliminating error in electrical connections with the power 20, ground 22 or signal conductors 24 and the need to distinguish interconnection elements during assembly.

[0032] While certain exemplary embodiments have been described and shown in the accompanying drawings, it is to be understood that such embodiments are merely illustrative and not restrictive of the current invention, and that this invention is not

restricted to the specific constructions and arrangements shown and described since modifications may occur to those ordinary skilled in the art.